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INFECTIVE ENDOCARDITIS – THE REVIEW

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ABSTRACT

Infective endocarditis (IE) is a serious and potentially life-threatening infection that affects the endocardium, heart valves, or implanted cardiac devices. It can present with a broad range of nonspecific symptoms, making early diagnosis difficult. The condition is typically confirmed through the detection of bacteremia and various imaging techniques, such as echocardiography, computed tomography (CT), and nuclear imaging. These tests can reveal anatomical changes or areas of altered metabolism, particularly on the heart valves or around foreign materials, such as prosthetic valves or cardiac devices. Treatment of IE generally involves a combination of antibiotic therapy and, in some cases, surgical intervention, with the decision for surgery depending on the patient's evolving clinical status. Over time, the epidemiology of IE has shifted, largely due to the increasing use of prosthetic valves and implantable devices, resulting in a higher incidence among older patients with multiple comorbidities. Historically, Streptococci and Enterococci were the primary causative organisms, but recent trends show a rise in infections caused by Staphylococci species and non-HACEK organisms. The management of IE requires early recognition, tailored antibiotic therapy, and timely surgical intervention when necessary. A multidisciplinary approach involving cardiologists, infectious disease specialists, and surgeons is essential for optimal care, given the complexity and high mortality associated with the condition. This review highlights the evolving epidemiology, diagnostic approaches, and treatment strategies for IE, emphasizing the importance of early detection and coordinated care.

KEYWORDS

Infective Endocarditis, Infective Endocarditis Treatment, Echocardiography, Cardiac Device Infection

CITATION

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Introduction

Infective endocarditis is a multisystem disease that affects the endocardial surface of the heart. Heart valves are the most frequently involved sites in infective endocarditis, while intra-cardiac devices and congenital heart anomalies are affected less commonly. The disease remains a serious condition with a high mortality rate, even with modern advances in its diagnosis and treatment. An increased risk of infective endocarditis is currently observed among elderly individuals, those with chronic illnesses, prosthetic heart valves, or those undergoing invasive medical procedures.

Epidemiology

Infective endocarditis is an uncommon disease, occurring at an estimated rate of up to 10 cases per 100,000 individuals annually [1]. Similarly, the mortality rate remains significant, with 15–30% of patients dying during their initial hospitalization [3]. In Western populations, infective endocarditis is diagnosed more frequently in men than in women, especially among older males, with the average age being around 67 years. Although infective endocarditis is more frequently seen in older adults, it also occurs in younger individuals — particularly those from developing nations or socioeconomically disadvantaged groups in Western countries — often due to risk factors such as intravenous drug use [4]. Infections associated with healthcare settings currently represent 25–30% of newly diagnosed endocarditis cases [1]. Although infective endocarditis is uncommon in the pediatric population, advancements in the management of congenital heart defects — a primary risk factor — have led to a rise in its incidence over recent decades [9]. Children at greatest risk include those with cyanotic heart anomalies, endocardial cushion defects, or conditions that produce high-velocity blood flow, such as ventricular septal defects [2].

Risk factors

Based on the analysis of numerous studies, the most common risk factors for infective endocarditis can be classified into cardiac-related and non-cardiac factors. Cardiac conditions that predispose to infective endocarditis include bicuspid aortic valve, mitral valve prolapse, rheumatic valve disease, congenital heart disease, prior infective endocarditis, and the presence of implanted cardiac devices. Non-cardiac factors that contribute to the risk of infective endocarditis include advanced age, intravenous drug use, chronic kidney disease, chronic liver disease, malignancy, diabetes, and an immunocompromised state. According to most studies, *Staphylococcus aureus* is the most common cause of infective endocarditis, accounting for about 27% of cases, followed by viridans streptococci, other streptococci, and enterococci. Together, these organisms are responsible for 80–90% of all cases [1].

Clinical symptoms

Infective endocarditis typically presents with systemic symptoms, most notably a fever exceeding 38°C in approximately 96% of cases, often accompanied by chills, night sweats, fatigue, and unintended weight loss. However, fever may be absent in patients previously treated with antibiotics or in infections caused by organisms of lower virulence. A newly developed regurgitant heart murmur is observed in about 48% of patients, while an existing murmur may worsen in 20%. Other characteristic features include signs of active vasculitis, such as splinter hemorrhages (thin red-brown streaks under the nails, seen in 8%), Roth spots (retinal hemorrhages with pale centers, in 2%), conjunctival hemorrhages (5%), and glomerulonephritis. Embolic events may affect the brain, lungs, or spleen, and splenomegaly is noted in roughly 11% of cases. Less frequently encountered are Osler's nodes (painful nodules on the fingertips or thenar areas, 3%), Janeway lesions (painless red or hemorrhagic spots on the palms or soles, 5%), and digital clubbing [5].

Diagnosis

The diagnosis of infective endocarditis relies on clinical symptoms, echocardiographic results, and microbiological evidence [6]. Echocardiography remains the primary imaging technique for diagnosing infective endocarditis (IE). Transthoracic echocardiography (TTE) is recommended for all patients with suspected IE. When TTE results are inconclusive or negative, transesophageal echocardiography (TEE) becomes essential for detecting lesions and assessing potential local complications. In individuals with prosthetic heart valves, the sensitivity of TTE drops to around 50%, likely due to acoustic shadowing caused by the prosthetic components. Three key echocardiographic features serve as diagnostic criteria for infective endocarditis: the presence of vegetations, the formation of an abscess, and the emergence of a new valvular leak or regurgitation [4]. In cases of infective endocarditis requiring cardiac surgery, tissue specimens may be collected directly from the infected area to undergo microbiological analysis, such as culture and 16S rRNA gene sequencing [7]. Early diagnosis of infective endocarditis is crucial to initiate appropriate treatment and to recognize patients at increased risk of complications who may benefit from prompt surgical intervention. A strong clinical suspicion should be maintained in individuals who use intravenous drugs or have a history of endocarditis, even prior to obtaining blood culture results [10].

Echocardiography

Echocardiography plays a key role in diagnosing infective endocarditis (IE), allowing for the detection of vegetations, abscesses, prosthetic valve dehiscence, and other complications—findings that are part of the modified Duke criteria. It also provides insights into the mechanism and severity of valve damage and allows assessment of ventricular function. In the diagnostic evaluation of suspected infective endocarditis involving native valves, transthoracic echocardiography (TTE) demonstrates moderate sensitivity (~75%) and high specificity (>90%). However, when TTE results are inconclusive or fail to confirm the diagnosis despite strong clinical indicators, transesophageal echocardiography (TEE) is the preferred modality, owing to its superior sensitivity exceeding 90%. TEE is particularly valuable in detecting complications such as prosthetic valve endocarditis or infections related to intracardiac devices, where the diagnostic yield of TTE is often limited. During hospitalization, TEE is used to monitor treatment response and disease progression. After therapy, it helps establish a new baseline for ongoing follow-up. Repeat imaging is advised if symptoms worsen or new abnormalities occur. Since IE carries a lifelong recurrence risk of 1–3% per year, long-term follow-up is essential. This should include regular TTE, assessment of inflammatory markers (at 1, 3, 6, and 12 months), monitoring for heart failure symptoms, and education on maintaining good oral hygiene [16][2][19].

Computed tomography

Cardiac CT is a particularly valuable imaging technique. In recent years, computed tomography (CT) has gained increased significance in diagnosing and managing infective endocarditis (IE), and it is now recommended for use in both native and prosthetic valve infections. Research has shown that multislice CT can detect valvular vegetations with accuracy comparable to transesophageal echocardiography (TEE). However, CT has a key advantage in its ability to better detect the extent of infection spread around the heart valves and identify pseudoaneurysms. The greater accuracy of CT, especially in detecting abscesses and pseudoaneurysms near the valves, is likely due to its higher spatial resolution. Furthermore, cardiac CT is useful in surgical planning, as it provides a non-invasive means to assess coronary artery disease. While CT has these advantages, TEE remains more effective for evaluating valve perforations and detecting intracardiac fistulas. Ultimately, both TEE and cardiac CT offer complementary insights, which are essential for the proper diagnosis and management of infective endocarditis [17][20].

Non-invasive treatment

Failure to diagnose the condition promptly can result in life-threatening complications. Effective treatment depends on the appropriate selection of bactericidal therapy and its administration for a sufficient duration. Since the 1940s, antibiotic treatment has typically involved prolonged intravenous use of primarily bactericidal agents [12]. The standard duration of therapy ranges from 4 to 6 weeks, depending on the causative microorganism and whether native or prosthetic heart valves are affected. Empirical antibiotic therapy should target the most common pathogens, including staphylococci, streptococci, and enterococci. Treatment guidelines for these organisms are largely informed by clinical experience and observational studies rather than randomized controlled trials, and therefore show minimal variation across published recommendations [1]. Once the specific pathogen has been identified, antimicrobial therapy should be tailored according to the susceptibility profile of the organism to ensure maximum efficacy. Gentamicin is no longer included in most current regimens for methicillin-sensitive *Staphylococcus aureus* (MSSA) due to insufficient evidence of clinical benefit. Moreover, ceftriaxone has gained recognition as a synergistic agent in the treatment of enterococcal endocarditis, leading to the recommendation of amoxicillin combined with ceftriaxone in European guidelines—particularly beneficial for patients with impaired renal function. Historically, infective endocarditis caused by HACEK organisms was treated with a combination of penicillin or ampicillin and an aminoglycoside such as gentamicin. However, the increasing prevalence of β-lactamase–producing strains has prompted changes in therapeutic strategies [13][21].

Invasive treatment

In some instances, complications resulting from infective endocarditis may be so severe that surgical management is required to ensure successful treatment. Between one-fifth and half of individuals diagnosed with infective endocarditis experience complications that make surgical valve replacement necessary for successful treatment [16]. Cardiac surgery has been demonstrated to significantly improve patient outcomes, conferring a survival benefit of up to 20% in selected populations. The primary indications for surgical management include the onset of heart failure, persistent infection despite adequate antibiotic therapy, and prevention of embolic events. Surgical urgency is typically stratified into three categories: emergency (within 24 hours), urgent (within 3 to 5 days), and non-urgent (performed during the same hospital admission but not immediately). For patients who remain hemodynamically stable after the resolution of infective endocarditis but continue to have valvular dysfunction, surgical repair or replacement should be scheduled following current valvular heart disease management guidelines [14]. Infections of prosthetic valves caused by Staphylococcus aureus carry a significant risk of death and frequently necessitate prompt surgical treatment when complications develop. Research demonstrates that timely surgical management leads to better survival rates in these patients. Early surgery may also be indicated in infections caused by other pathogens, including gram-negative non-HACEK bacteria such as *Pseudomonas aeruginosa*, multidrug-resistant gram-negative bacilli, multidrug-resistant enterococci, and fungal species [15].

Prognosis

The outcome of infective endocarditis depends greatly on factors such as the infection's severity, occurrence of complications, existing health conditions, and whether the valve involved is natural or prosthetic. The mortality rate during hospitalization is about 18%, rising to nearly 40% after one year. Cases of infective endocarditis affecting prosthetic valves within 60 days post-surgery show the highest hospital mortality rates, reaching approximately 30%. While almost half of the patients with infective endocarditis undergo surgical treatment, undergoing surgery does not seem to increase the likelihood of death during hospitalization [18].

Conclusions

Infective endocarditis (IE) continues to be a serious and potentially life-threatening condition that demands prompt and accurate diagnosis alongside a well-coordinated, multidisciplinary treatment plan involving various medical specialties. Due to the disease's complexity and its broad spectrum of symptoms and complications, cooperation among experts in cardiology, surgery, microbiology, and infectious diseases is crucial. Improvements in diagnostic tools, including advanced imaging and microbiological methods, are key to early identification of IE and initiating effective therapy. Nonetheless, some elements remain uncertain, such as the most suitable imaging techniques, the role of newer antibiotic regimens, and the actual effectiveness of preventive measures. Despite better survival rates, IE still presents a considerable risk, especially for patients with additional health issues or more severe disease manifestations. Surgical treatment is recommended in specific situations, like heart failure, persistent infection, or a heightened risk of embolism, but decisions about surgery should be individualized. Continued research offers hope for innovative technologies and treatments that could enhance patient outcomes further. More clinical trials and investigations are necessary to broaden our understanding of IE and optimize therapeutic strategies. Maintaining a collaborative, interdisciplinary approach is vital to lowering mortality rates and improving the long-term well-being of those affected.

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REFERENCES

1. Rajani, R., & Klein, J. L. (2020). Infective endocarditis: A contemporary update. *Clinical Medicine, 20*(1), 31–35. https://doi.org/10.7861/clinmed.cme.20.1.1
2. Hubers, S. A., DeSimone, D. C., Gersh, B. J., & Anavekar, N. S. (2020). Infective endocarditis: A contemporary review. *Mayo Clinic Proceedings, 95*(5), 982–997. https://doi.org/10.1016/j.mayocp.2019.12.008
3. Cahill, T. J., & Prendergast, B. D. (2016). Infective endocarditis. *The Lancet, 387*(10021), 882–893. https://doi.org/10.1016/S0140-6736(15)00067-7
4. Mills, M. T., Al-Mohammad, A., & Warriner, D. R. (2022). Changes and advances in the field of infective endocarditis. *British Journal of Hospital Medicine, 83*(3), 1–11. https://doi.org/10.12968/hmed.2021.0510
5. Rajani, R., & Klein, J. L. (2020). Infective endocarditis: A contemporary update. *Clinical Medicine, 20*(1), 31–35. https://doi.org/10.7861/clinmed.cme.20.1.1
6. Tornos, P., Gonzalez-Alujas, T., Thuny, F., & Habib, G. (2011). Infective endocarditis: The European viewpoint. *Current Problems in Cardiology, 36*(5), 175–222. https://doi.org/10.1016/j.cpcardiol.2011.03.004
7. Damlin, A., Westling, K., Maret, E., Stålsby Lundborg, C., Caidahl, K., & Eriksson, M. J. (2019). Associations between echocardiographic manifestations and bacterial species in patients with infective endocarditis: A cohort study. *BMC Infectious Diseases, 19*(1), Article 1052. https://doi.org/10.1186/s12879-019-4682-z
8. Mostaghim, A. S., Lo, H. Y. A., & Khardori, N. (2017). A retrospective epidemiologic study to define risk factors, microbiology, and clinical outcomes of infective endocarditis in a large tertiary-care teaching hospital. *SAGE Open Medicine, 5*, 2050312117741772. https://doi.org/10.1177/2050312117741772
9. Eleyan, L., Khan, A. A., Musollari, G., Chandiramani, A. S., Shaikh, S., Salha, A., Tarmahomed, A., & Harky, A. (2021). Infective endocarditis in paediatric population. *European Journal of Pediatrics, 180*(10), 3089–3100. https://doi.org/10.1007/s00431-021-04062-7
10. Chopra, T., & Kaatz, G. W. (2010). Treatment strategies for infective endocarditis. *Expert Opinion on Pharmacotherapy, 11*(3), 345–360. https://doi.org/10.1517/14656560903496430
11. Calza, L., Manfredi, R., & Chiodo, F. (2004). Infective endocarditis: A review of the best treatment options. *Expert Opinion on Pharmacotherapy, 5*(9), 1899–1916. https://doi.org/10.1517/14656566.5.9.1899
12. Østergaard, L., Valeur, N., Tuxen, C. D., Bundgaard, H., Iversen, K., Moser, C., Helweg-Larsen, J., Smerup, M., Bruun, N. E., & Fosbøl, E. (2022). [Infective endocarditis]. *Ugeskrift for Laeger, 184*(12), V10210751.
13. Sharara, S. L., Tayyar, R., Kanafani, Z. A., & Kanj, S. S. (2016). HACEK endocarditis: A review. *Expert Review of Anti-Infective Therapy, 14*(6), 539–545. https://doi.org/10.1080/14787210.2016.1184085
14. Imazio, M. (2024). The 2023 new European guidelines on infective endocarditis: Main novelties and implications for clinical practice. *Journal of Cardiovascular Medicine, 25*(10), 718–726. https://doi.org/10.2459/JCM.0000000000001651
15. Khalil, H., & Soufi, S. (2022). Prosthetic valve endocarditis. In *StatPearls*. StatPearls Publishing.
16. Yang, E., & Frazee, B. W. (2018). Infective endocarditis. *Emergency Medicine Clinics of North America, 36*(4), 645–663. https://doi.org/10.1016/j.emc.2018.06.002
17. Dale, S., Tayyem, Z., & Maceyko, S. (2024). Endocarditis: A review of recent literature. *Current Emergency and Hospital Medicine Reports, 12*, 67–73. https://doi.org/10.1007/s40138-024-00292-9
18. Yallowitz, A. W., & Decker, L. C. (2023). Infectious endocarditis. In *StatPearls*. StatPearls Publishing.
19. Kamde, S. P., & Anjankar, A. (2022). Pathogenesis, diagnosis, antimicrobial therapy, and management of infective endocarditis, and its complications. *Cureus, 14*(9), Article e29182. https://doi.org/10.7759/cureus.29182
20. Dalebout, E. M., Hirsch, A., Kluin, J., Galema, T. W., Roos-Hesselink, J. W., & Budde, R. P. J. (2024). Computed tomography in infectious endocarditis. *Journal of the Society for Cardiovascular Angiography & Interventions, 3*(3, Part B), Article 101292. https://doi.org/10.1016/j.jscai.2023.101292
21. Hoen, B., Elfarra, M., Huttin, O., Goehringer, F., Venner, C., & l'Endocarditis Team du CHU de Nancy. (2019). Traitement de l'endocardite infectieuse [Treatment of infectious endocarditis]. *Presse Médicale, 48*(5), 539–548. https://doi.org/10.1016/j.lpm.2019.04.015